

CLAIMS:

I claim:

1. A vehicle, comprising:
an instrument panel;
a front seat on which an occupant sits opposite said instrument panel;
a knee protection airbag having a storage position and a deployed position; and
an inflator for inflating said airbag from said storage position to said deployed position, said airbag being arranged to substantially fill a space between the knees of the occupant when seated on said front seat and said instrument panel in said deployed position.
2. The vehicle of claim 1, further comprising an anticipatory crash sensor system for forecasting a crash between the vehicle and another object prior to impact of the vehicle by the other object, said anticipatory crash sensor system being coupled to said inflator and arranged to direct said inflator to inflate said airbag prior to the crash.
3. The vehicle of claim 1, wherein said airbag comprises:
at least two pieces of substantially flat inelastic plastic film having peripheral edges, one of said at least two pieces having an inlet port for inflow of inflating fluid; and
attachment means for attaching said at least two pieces of inelastic plastic film together at least at said peripheral edges to form a substantially sealed airbag.
4. The vehicle of claim 3, wherein said airbag has interconnected chambers formed by attaching said pieces of inelastic plastic film at locations other than at said peripheral edges
5. The vehicle of claim 1, wherein said airbag comprises inelastic plastic film, said airbag having an inlet port for inflow of inflating fluid and at least one variable outlet vent, said at least one variable outlet vent comprising pressure responsive means for controlling opening of said at least one variable outlet vent to thereby control flow of gas through said at least one variable outlet vet in response to pressure in said airbag.
6. The vehicle of claim 1, wherein said airbag comprises a single piece of inelastic plastic film having at least one inlet port for inflow of inflating fluid.
7. The vehicle of claim 1, wherein said airbag comprises an outer airbag made of at least one layer of plastic film and an inner airbag made of at least one layer of plastic film and arranged to fill an interior volume of said outer airbag when inflated.

8. The vehicle of claim 1, wherein said airbag comprises a first sheet of film and a member arranged in connection with said first sheet of film for arresting the propagation of a tear in said first sheet of film, said member being selected from the group consisting of (a) a network of multi-directional material strips; (b) a second sheet of film having substantially anisotropic tear properties with the direction of tear resistance of said second sheet of film being different than a direction of tear resistance of said first sheet of film; and (c) a thermoplastic elastomeric material arranged at specific locations such that said locations are thicker in comparison to an average thickness of said first sheet of film.

9. The vehicle of claim 1, wherein said airbag comprises a composite airbag having at least one layer of inelastic plastic film attached to a layer of a more elastic plastic film, said second layer serving to blunt the propagation of a tear.

10. The vehicle of claim 1, further comprising a net surrounding said airbag during and after deployment of said airbag.

11. The vehicle of claim 1, wherein said inflator comprises:
a gas generator for producing pressurized gas to inflate said airbag; and
aspiration means for combining gas from the passenger compartment of the vehicle with pressurized gas from said gas generator and directing the combined flow of gas into said airbag.

12. The vehicle of claim 1, wherein said airbag comprises a plurality of material sections defining a plurality of interconnected cells, said cells having a width less than a width of the occupant's knees.

13. The vehicle of claim 12, wherein said airbag includes one-way valves arranged in said material sections between said cells to control flow of inflating fluid between said cells.

14. The vehicle of claim 13, wherein one of said valves leads to each of said cells, said valves being arranged to close once a predetermined pressure prevails in the respective one of said cells to prevent fluid outflow from said cell.

15. The vehicle of claim 1, wherein said airbag has a fixed vent or a variable vent for venting inflating fluid from an interior of said airbag.

16. The vehicle of claim 1, wherein said airbag is arranged to conform to the shape of the knees of the occupant.

17. A vehicle including a knee bolster airbag system for protecting the knees of an occupant of the vehicle, comprising:

- an airbag having a plurality of cells;
- an inflator arranged to inflate said airbag; and
- a housing for storing said airbag, said housing being mounted in the vehicle in a position in which said airbag engages lower extremities of the occupant upon inflation.

18. The vehicle of claim 17, wherein said airbag is dimensioned to occupy a space between the occupant's legs and structural components of an instrument panel of the vehicle when inflated.

19. A vehicle including a knee bolster airbag system, comprising:

- an airbag having a plurality of chambers; and
- an inflator arranged to inflate said airbag, said airbag being arranged to engage the lower extremities of a vehicle occupant upon inflation and distribute impact force imposed by the lower extremities over said chambers.

20. The vehicle of claim 19, wherein said airbag provides a soft surface adapted to engage the lower extremities of an occupant.

21. The vehicle of claim 19, wherein said airbag is arranged such that when inflated, said airbag occupies a space between the occupant's legs and the vehicle instrument panel such that the instrument panel provides support for said airbag.

22. The vehicle of claim 19, wherein said inflator is arranged to direct gas directly into only a portion of said chambers, said airbag comprises a plurality of one-way valves arranged between adjacent ones of said chambers to enable flow of gas from said inflator to all of said chambers.

23. A motor vehicle, comprising:

- an instrument panel;
- a compartmentalized airbag knee bolster device mounted to said instrument panel, said knee bolster device comprising an inflator for providing pressurized gas upon actuation thereof and a compartmentalized airbag having a plurality of compartments in communication with said inflator; and
- mounting means for mounting said compartmentalized airbag knee bolster device to said instrument panel such that said compartmentalized airbag substantially occupies a space between said instrument panel and the knees or lower extremities of an occupant situated in front of said instrument panel when inflated.

24. The vehicle of claim 23, wherein said compartmentalized airbag comprises a plurality of material sections defining a plurality of compartments and one-way valves arranged in said material sections between said compartments to control flow of inflating fluid between said compartments.

25. The vehicle of claim 23, wherein each of said compartments has a width approximately equal to or less than the width of a knee of an occupant of the motor vehicle.

26. An inflatable tubular bolster for a vehicle, comprising:
an inflatable airbag comprising a plurality of cells;
a gas generator fluidly connected to the airbag via a gas conduit; and
a crash sensor connected to said gas generator for detecting an impact involving the vehicle such that when an impact is detected by said crash sensor, said gas generator is directed to cause said cells to be inflated and said airbag deploys from a stowed position downward and rearward into a position below an instrument panel of the vehicle such that it restrains forward and downward movement of an occupant situated in front of the instrument panel.

27. The inflatable tubular bolster of claim 26, wherein said airbag is arranged to deploy in front of an occupant's knees and inhibits forward and downward movement of said occupant.

28. The inflatable tubular bolster of claim 26, wherein said airbag attains an internal pressure of in excess of 1 bar gage after inflation.

29. A system for protecting occupants of a vehicle during a crash involving the vehicle, comprising:
a plurality of inflators for generating pressurized gas;
a crash sensor system for controlling said inflators to begin generating pressurized gas based on a crash involving the vehicle;
a plurality of primary airbags each directly connected to a respective one of said inflators and receiving pressurized gas directly from said respective inflator; and
at least one secondary airbag in flow communication with each of said primary airbags such that inflation of said primary airbag by said respective inflator causes inflation of said at least one secondary airbag.

30. The system of claim 29, wherein said at least one secondary airbag comprises a plurality of secondary airbags distanced sequentially from said primary airbag such that gas from said primary airbag passes into a first one of said secondary airbags and from said first secondary airbag to a second one of said secondary airbags and so on.

31. The system of claim 30, wherein said secondary airbags include a one-way valve which enables flow of gas from each of said secondary airbags to an adjoining downstream one of said secondary airbags.

32. The system of claim 29, wherein said crash system includes an anticipatory crash sensor arranged to determine whether a crash involving the vehicle is about to occur and to direct said inflators to generate gas prior to the crash such that said primary airbags and said at least one secondary airbags are inflated prior to the crash.

33. The system of claim 29, wherein each of said primary airbags includes a one-way valve which enable flow of gas from said primary airbag to an adjoining one of said at least one secondary airbag.

34. The system of claim 29, wherein at least one of said inflators comprises:
a gas generator for producing pressurized gas to inflate a respective one of said primary airbags; and
aspiration means for combining gas from the passenger compartment of the vehicle with pressurized gas from said gas generator and directing the combined flow of gas into said respective primary airbag.